# Chiloguembelina Loeblich and Tappan and Related Foraminifera from the Lower Tertiary of Trinidad, B. W. I.

By J. P. Beckmann [1]

## Introduction

Recent studies by Montanaro Gallitelli (1955) indicate that *Guembelina* Egger, 1899, is a junior synonym of *Heterohelix* Ehrenberg, 1843, and therefore invalid. Loeblich and Tappan (1956) have erected the genus *Chiloguembelina*, to include some Tertiary species previously referred to *Guembelina*. *Chiloguembelina* is distinguished from the Cretaceous genus *Heterohelix* by the absence of an early coiled stage, the presence of necklike apertural extensions, and the tendency to develop a twisted test and asymmetrical aperture.

In Trinidad, *Chiloguembelina* is present in a great number of planktonic faunas of Paleocene, Eocene, and Oligocene age. The specimens are usually well preserved and the morphological details are easily seen, except in some middle Eocene samples, where the number of good specimens is sometimes insufficient.

It is the purpose of this paper to describe the species of *Chiloguembelina* from the lower Tertiary of Trinidad, to establish their stratigraphic ranges, and to discuss their relationships to the Heterohelicidae and Buliminidae.

### Acknowledgments

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### Stratigraphy

The species of *Chiloguembelina*, *Guembelitria* and *Zeauvigerina* described in this paper were obtained from samples from the following formations:

- Cipero formation, lower part (Oligocene)
- San Fernando formation (uppermost Eocene)
- Navet formation (middle Eocene to lower part of upper Eocene)
- Lizard Springs formation (Paleocene to lower Eocene).

Details of the further subdivision of these formations are given in the range chart (text-fig. 16). The complete data, with descriptions of the planktonic Foraminifera, have been published by Bolli (1957a, 1957b, 1957c).

The generic names of the zonal markers used in this paper are in accordance with the recent classification of planktonic Foraminifera by Bolli, Loeblich, and Tappan (1957).

### General Morphology

The chamber arrangement of the Tertiary species of *Chiloguembelina* is biserial throughout. None of the species investigated by the author show the early coil described from the Cretaceous Heterohelicidae (Loeblich, 1951; Montanaro Gallitelli, 1955). The presence of a triserial stage in *Guembelina venezuelana* Nuttall, recorded by Hofker (1954), could not be confirmed. The diameter of the proloculum is from 0.005 to 0.02 mm. Its size varies from species to species, as well as within one species. In the latter case, this seems to indicate the existence of megalospheric and microspheric generations.

The characteristics fairly constant within one species, and therefore most useful for systematic purposes, are: The aperture—its shape and position (eccentric or in the center of the apertural face), and the presence or absence of transparent collars or

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FIGURE 14.—Variability of species of *Chiloguembelina* (all figures approximately × 120; a list of the sample localities is given on p. 88).

Numbers 1–4. *Chiloguembelina crinita* (Glaessner), (USNM P5754) from sample 228674.

Numbers 5–8. *Chiloguembelina cubensis* (Palmer), (USNM P5757), from sample 215702.

Numbers 9–11, 14–18, 20–23. *Chiloguembelina martini* (Pijpers):
9–11 (USNM P5760a–c), from sample 177760, *Hantkenina aragonensis* zone. 14–18 (USNM P5761a–e) from sample 221009, *Porticulasphaera mexicana* zone. 20–23 (USNM P5762a–d), from sample 238622, *Globigerapsis semiinvoluta* zone.

Numbers 12, 13, 19. *Chiloguembelina* cf. *mauriciana* Howe and Roberts:
12, 13 (USNM P5765a, b), from sample 177760, *Hantkenina aragonensis* zone. 19 (USNM P5766), from sample 221009, *Porticulasphaera mexicana* zone.

Numbers 24–27. *Chiloguembelina midwayensis midwayensis* (Cushman) (USNM P5769a–d), from sample 232705.

Numbers 28–31. *Chiloguembelina midwayensis strombiformis* Beckmann, new subspecies (USNM P5772 a–d) from sample 228674.

Numbers 32–35. *Chiloguembelina midwayensis subcylindrica* Beckmann, new subspecies (USNM P5776a–d), from sample 228484.


FIGURE 15.—Variability of species of *Chiloguembelina* and *Zeauvigerina* (all figures approximately × 120; a list of the sample localities is given on p. 88).

Numbers 36–38. *Chiloguembelina parallela* Beckmann, new species (USNM P5781a–c), from sample 232994. Small end chamber visible in Nos. 36 and 38 (partly broken).

Numbers 39–42. *Chiloguembelina subtriangularis* Beckmann, new species (USNM P5784a–d), from sample 232706.

Numbers 43–45. *Chiloguembelina trinitatensis* (Cushman and Renz) (USNM P5787a–c), from sample 50315.

Numbers 46–48. *Chiloguembelina victoriana* Beckmann, new species (USNM P5791a–c), from sample 193785.

Numbers 49–58. *Chiloguembelina wilcoxensis* (Cushman and Ponton): 49–52 (USNM P5796a–d), from sample 223473, *Globorotalia pseudomenardii* zone. 53–55 (USNM P5797a–c), from sample 223470, *Globorotalia velascoensis* zone. 56–58 (USNM P5798a–c), from sample 102301, *Globorotalia formosa formosa* zone. Small subterminal end chamber visible in No. 56.

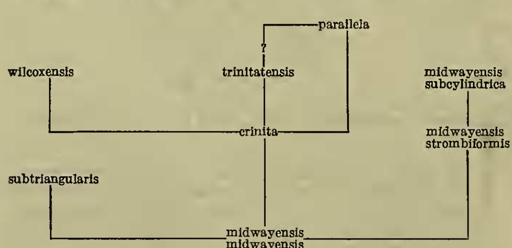
Numbers 59–62. *Zeauvigerina aegyptiaca* Said and Kenawy (USNM P5805a–d), from sample 228674. Small end chamber visible in Nos. 59–61, partly broken in Nos. 59 and 61.

flanges; the general shape of the chambers (compressed or globular); and the surface of the wall (smooth or spinose). Other features, such as the number and the rate of increase in size of the chambers or the nature of the sutures (oblique or horizontal, straight or curved) are more variable, but can in certain cases be used for the distinction of subspecies.

Whereas the aperture is usually characteristic for each species, there is a considerable diversity within the whole *Chiloguembelina* group. Extremely asymmetrical apertures with a transparent flange occur in *Chiloguembelina midwayensis* (Cushman) and *Chiloguembelina martini* (Pijpers) (pl. 21, figs. 1–3, 6, 14). The asymmetrical shape and position of the aperture is not due to lateral compression or distortion of the test, but is a character which alternates regularly within one specimen as a result of the biserial arrangement of the chambers. On the other hand, *Chiloguembelina wilcoxensis* (Cushman and Ponton) and *Chiloguembelina trinitatensis* (Cushman and Renz) have a symmetrical, semicircular to crescentic aperture, similar to that of many Cretaceous species of *Heterohelix* (pl. 21, figs. 7, 10, 12). Another variant is *Chiloguembelina parallela,* new species, where the aperture is high and narrow, symmetrical in shape and situated in the center of the apertural face (pl. 21, fig. 8).

In *Chiloguembelina midwayensis subcylindrica,* new subspecies, *C. parallela,* new species, and *C. wilcoxensis* (Cushman and Ponton), the aperture of the last regular chamber is occasionally covered by a small chamber of irregular shape (pl. 21, figs. 3, 13; text-fig. 15, Nos. 36, 38, 56). The wall surface of this small chamber is usually smoother than that of the previous chambers. This feature resembles the terminal chamber of *Zeauvigerina* and suggests a close relationship between this genus and *Chiloguembelina.* The tubular neck characteristic of *Zeauvigerina* is, however, absent in *Chiloguembelina.*

It is interesting to note that *Chiloguembelina midwayensis subcylindrica,* new subspecies, *C. parallela,* new species, and *C. wilcoxensis* (Cushman and Ponton), the only three species which have this end chamber, seem to be the last stages of three different evolutionary lines, as follows:




This suggests that the end chamber in *Chiloguembelina* is a gerontic stage, which is developed shortly before the extinction of an evolutionary line.

## Evolutionary Trends and Relationships to Other Genera

It is easy to recognize evolutionary trends in the Paleocene-lower Eocene *Chiloguembelina* species from the Lizard Springs formation. The faunas are well preserved and contain intermediate forms which indicate the origin of the various species. On the other hand, it has not been possible to trace definite evolutionary trends in *Chiloguembelina* within the Navet and Cipero formations.

The preceding discussion of morphological details indicates that the genus *Chiloguembelina* includes species showing various apertural characteristics. Distinctive features, however, such as a symmetrical aperture or a small terminal chamber, occur independently in different evolutionary lines. Species showing various types of apertures and shapes of the test are apparently closely related and it seems therefore reasonable to include them in one single genus.

The main features distinguishing *Chiloguembelina* from *Heterohelix,* are the absence of a coiled early stage, the tendency to develop a twisted test, and the presence of necklike extensions or flaps around the aperture. The chamber arrangement is biserial as in *Bolivina,* and some species of *Chiloguembelina* and *Bolivina* are similar in appearance. However, *Chiloguembelina* has inflated chambers, no ornamentation, but often a hispid wall surface. The aperture is rarely so high and narrow as in typical *Bolivina.* Further characteristics of *Chiloguembelina* are the twisted test and the absence of an internal structure connecting the apertures of successive chambers. There is also a difference in the habitat of the two genera. The frequency of *Chiloguembelina* in *Globigerina* marls suggests a planktonic mode of life for this genus, whereas *Bolivina* is generally regarded as bottom-living.

The relationship between *Chiloguembelina* and *Zeauvigerina* has been mentioned above.

## Stratigraphic Occurrence

The stratigraphic range (see text-fig. 16) of *Chiloguembelina* in Trinidad is from Paleocene to Oligocene. This is in agreement with the observations of most previous authors. None of the *Chiloguembelina* species described in this paper occur in the Upper Cretaceous of Trinidad. The author has not systematically checked upper Oligocene, Miocene, or Recent faunas for the presence of *Chiloguembelina,* and it is possible that additional species will be found in these faunas.

The variety of species of *Chiloguembelina* reaches a first climax around the Paleocene-lower Eocene bound-

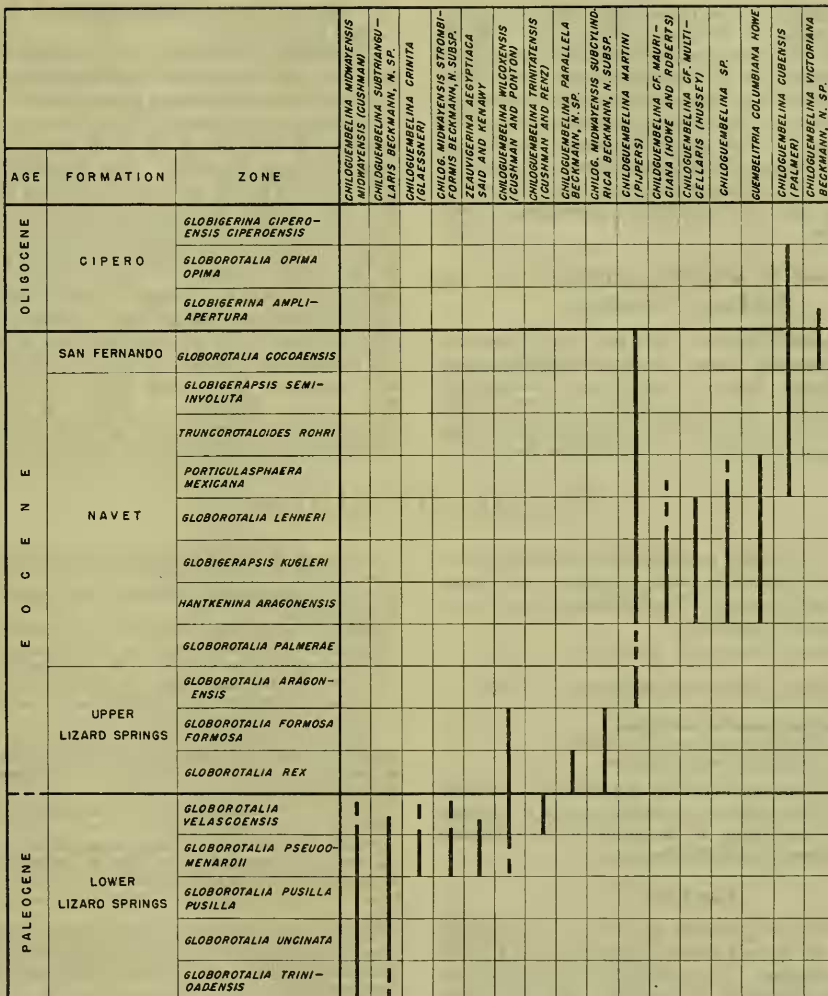



FIGURE 16.—Species distribution of *Chiloguembelina*, *Guembelitria*, and *Zeauvigerina* in the Tertiary of Trinidad, B. W. I.

ary, at a level which corresponds to the upper Midway and Wilcox groups of North America. A complete change of fauna takes place in the uppermost part of the Lizard Springs formation. After the extinction of all Paleocene-lower Eocene species, *Chiloguembelina martini* (Pijpers) appears in the *Globorotalia aragonensis* zone and becomes the dominant Eocene species in size and frequency. Some details of the distribution of other species in the lower to middle part of the Navet formation remain uncertain, owing to the insufficient number of samples from the *Globorotalia palmerae* zone and the poor preservation of the specimens from the *Globigerapsis kugleri* and *Globorotalia lehneri* zones.

*Chiloguembelina martini* disappears at the Eocene-Oligocene boundary and is therefore a good Eocene marker. The only survivors in the Oligocene are *Chiloguembelina cubensis* (Palmer) and *Chiloguembelina victoriana*, new species. The latter species died out suddenly in the middle of the *Globigerina ampliapertura* zone, and the last occurrence of *Chiloguembelina cubensis* is in the *Globorotalia opima opima* zone.

Specimens of *Chiloguembelina* occur in great numbers in most of the Paleocene, Eocene, and lower Oligocene *Globigerina* marls of Trinidad. They can be easily recognized in a fauna consisting of floods of *Globigerina* and *Globorotalia* and are therefore useful for a first quick estimation of the age of a sample. *Chiloguembelina* is also found in samples containing mainly a benthonic fauna. This type of fauna is well known from the Gulf Coast of the United States. *Chiloguembelina* is then often the most accurate means of correlating these faunas with planktonic assemblages from other localities.

### Previous Records of Chiloguembelina from the Tertiary of Trinidad

Cushman and Jarvis (in Cushman, 1933) describe *Guembelina goodwini* from the Hospital Hill marl of Trinidad (upper Eocene, *Globigerapsis semiinvoluta* zone). Cushman and Renz (1948, p. 23) report *Guembelina goodwini* from all units of the Navet formation except the Ramdat marl. *Gümbelina goodwini* is now regarded as a junior synonym of *Textularia martini* Pijpers (1933).

*Guembelina trinitatensis* was described from the Paleocene of Soldado Rock (off the southwest coast of Trinidad) by Cushman and Renz (1942).

*Guembelina ultimatumida* White is reported by Cushman and Renz (1946, p. 36, pl. 6, figs. 1, 2) from the Lizard Springs formation. This identification has to be revised, as it was probably influenced by the belief that the Lizard Springs formation was of Upper Cretaceous age. A re-examination of the type assemblages of the Lizard Springs formation, prepared by H. H. Renz, shows that they include *Guembelina* representing several Tertiary species (*Chiloguembelina crinita-midwayensis* group, *Chiloguembelina wilcoxensis* and *Chiloguembelina trinitatensis*), but do not contain any Cretaceous species. It is not possible to identify with certainty the figures given by Cushman and Renz (1946). Figure 1 on plate 6 of their paper is probably a *Chiloguembelina crinita* or *midwayensis strombiformis;* figure 2 seems to be a different genus.

## Systematic Descriptions

Fourteen species and subspecies of *Chiloguembelina*, one species of *Guembelitria* and one species of *Zeauvigerina* are here recorded. The following new species and subspecies are described:

- *Chiloguembelina midwayensis strombiformis*, new subspecies
- *Chiloguembelina midwayensis subcylindrica*, new subspecies
- *Chiloguembelina parallela*, new species
- *Chiloguembelina subtriangularis*, new species
- *Chiloguembelina victoriana*, new species

The figured types are deposited in the U. S. National Museum in Washington. A duplicate set of the species described in this paper is deposited in the Natural History Museum, Basel, Switzerland.

### Localities

The following list gives the localities for the samples from which the figured holotype, paratypes and hypotypes were obtained. The sample numbers given here and in the explanations of the plates and text-figures are the catalogue numbers of the paleontological collection of The Trinidad Oil Company.

50315: About 1¼ mile southeast of the junction between the Rio Claro-Guayaguayare Road and the road to the abandoned Lizard Springs oilfield, southeast Trinidad (locality described in detail by Cushman and Renz, 1946), in eastern tributary of Ampelu River, 185 feet from its junction with Ampelu River, collected by H. H. Renz (282).

102301: 120 feet north of sample 50315, collected by K. W. Barr (6972).

177760: In ravine between Brasso-Tamana Road and Navet River, central Trinidad, 1,450 feet south of milepost 12½ of Brasso-Tamana Road (see Bolli, 1957b, text-fig. 25), collected by H. G. Kugler (8820).

178162: 4,570 feet south of milepost 9¾ of Brasso-Tamana Road, central Trinidad; in small northern tributary of Nariva River, 100 feet from its junction with the Nariva River (coordinates N:313850 links; E:478580 links), collected by H. G. Kugler (9073).

193785: Cipero Coast, San Fernando, Trinidad, 475 feet southwest of fixed point at northern end of coast section (Bolli, 1957c, text-fig. 19), collected by J. B. Saunders (19).

215702: Cipero Coast, San Fernando, Trinidad, 276 feet southwest of fixed point at northern end of coast section, collected by H. M. Bolli (313B).

217995: 850 feet west of road junction between The Avenue and Bon Accord Road, Pointe-a-Pierre, Trinidad, in cutting west of tank 127, 200 feet north of The Avenue, collected by L. W. Hawkins (408).

221009: Same locality as 221995, collected by H. G. Kugler (10781).

223470–73: Trinidad Petroleum Development Co. well Moruga No. 15, south Trinidad (coordinates N:149878 links; E:497002 links); 223470 from core at 3,593–3,613 feet (upper part), 223472 from core at 3,720–3,740 feet, 223473 from core at 3,796–3,816 feet.

228484: Left bank tributary of Cascas River, 180 feet from its junction with the Cascas River, Moruga, south Trinidad (coordinates N:138700 links; E:435000 links), collected by L. W. Hawkins (1831).

228674: Northeastern bank of tank farm at the old club site, Pointe-a-Pierre, Trinidad (coordinates N:256950 links; E:380000 links), collected by H. G Kugler (10832).

232705–6, 232994: The Trinidad Oil Company well Guayaguayare No. 159, southeast Trinidad (coordinates N:151361 links; E:554095 links); 232705 from core at 4,524–4,536 feet, 232706 from core at 4,778–4,790 feet, 232994 from core at 3,707–3,713 feet.

238622: Hospital Hill, San Fernando, Trinidad, on eastern side of road leading from King's Wharf to Point Bontour (coordinates N:234850 links; E:355650 links), collected by H. M. Bolli (536).

240966: Branch of Pointe-a-Pierre Road, between Joga Grant Street and Jarvis Street, San Fernando, Trinidad, 90 feet east of southern end of Joga Grant Street, collected by H. G. Kugler (9613).

## Family Heterohelicidae Cushman, 1927

### Genus Chiloguembelina Loeblich and Tappan, 1956

#### Chiloguembelina crinita (Glaessner)

Plate 21, Figure 4; Text-figure 14 (1–4)

*Gümbelina crinita* Glaessner, 1937, p. 383, pl. 4, fig. 34 (Paleocene or lower Eocene, Caucasus, U.S.S.R.).

The general shape of the test, the spinose surface of the wall and the semicircular aperture agree well with the type description. *Chiloguembelina crinita* is closely related to *C. midwayensis* (Cushman), but differs in the more globular shape of its chambers and the more rapid increase in chamber size. The wall of *C. crinita* is more spinose and resembles that of *C. midwayensis strombiformis*, new subspecies. This subspecies, however, has less inflated chambers and in general a lower and more elongate aperture.

Length: 0.2–0.3 mm.

Occurrence: Lower Lizard Springs formation (Paleocene), *Globorotalia pseudomenardii* zone (common) and *Globorotalia velascoensis* zone (lower part, rare).

Types: Figured hypotypes (USNM P5753, P5754) and unfigured hypotypes (USMN P5755).

#### Chiloguembelina cubensis (Palmer)

Plate 21, Figure 21; Text-figure 14 (5–8)

*Gümbelina cubensis* Palmer, 1934, p. 74, text-figs. 1–6 (upper Eocene and lower Oligocene, Cuba).—Palmer and Bermudez, 1936, p. 284 (lower Oligocene, Cuba).— Bermudez, 1938, p. 11 (Eocene, Cuba).—Cushman, 1939, p. 63, pl. 10, fig. 54 (Eocene, North Atlantic Ocean).—Palmer, 1940, p. 292 (Oligocene, Cuba).—Cushman, 1946, p. 22, pl. 4, fig. 28 (Eocene, Alabama, U. S. A.).—Cushman and Todd, 1946b, p. 90 (Oligocene, Mississippi, U. S. A.).—Renz, 1948, p. 138, pl. 6, fig. 9 (Oligo-Miocene, Venezuela).— Bandy, 1949, p. 124, pl. 24, fig. 3 (upper Eocene, Alabama, U. S. A.).—Bermudez, 1949, p. 175, pl. 11, fig. 40 (middle Oligocene, Cuba).—Beckmann, 1953, p. 364, pl. 21, fig. 2 (Oligocene, Barbados, B. W. I.).

*Gümbelina cubensis* Palmer var. *heterostoma* Bermudez, 1937, p. 143, pl. 17, figs. 5–7 (upper Eocene, Cuba).—Cushman and Stone, 1947, p. 11, pl. 1, fig. 29 (Eocene, Peru).— Bandy, 1949, p. 124, pl. 24, fig. 7 (upper Eocene, Alabama, U. S. A.)

Most well-preserved specimens from Trinidad have the slightly asymmetrical aperture described in *Guembelina cubensis* var. *heterostoma* Bermudez. Forms with a symmetrical aperture, as shown in D. K. Palmer's type figures of *G. cubensis*, are rare and seem only to be extreme variants of the group. By courtesy of Dr. Bermudez, the author obtained topotypes of *Chiloguembelina cubensis* and the variety *heterostoma*. Specimens with asymmetrical apertures occur at both localities. The author is therefore inclined to consider the variety *heterostoma* as a synonym of *C. cubensis*. H. M. Bolli (personal communication) came to the same conclusion after a comparison of the types deposited in the U. S. National Museum.

Length: 0.12–0.25 mm.

Occurrence: Eocene and lower Oligocene, *Porticulasphaera mexicana* zone to *Globorotalia opima opima* zone.

Single, badly preserved specimens, which may be closely related to *Chiloguembelina cubensis*, are found in the lower part of the Navet formation (*Hantkenina aragonensis* and *Globigerapsis kugleri* zones.

References to *Chiloguembelina cubensis* from Cuba (Palmer, 1940), Venezuela (Renz, 1948) and the Dominican Republic (Bermudez, 1949) seem to be from younger strata than the highest occurrence of the species in Trinidad. A re-examination of these localities will be necessary to check the possibility of reworking.

Types: Figured hypotypes (USNM P5756, P5757) and unfigured hypotypes (USNM P5758).

#### Chiloguembelina martini (Pijpers)

Plate 21, Figure 14; Text-figure 14 (9–11, 14–18, 20–23)

*Textularia martini* Pijpers, 1933, p. 57, figs. 6–10 (upper Eocene, Bonaire, D. W. I.).

*Gümbelina martini* (Pijpers), Drooger, 1953, p. 100, pl. 1, fig. 2; text-fig. 4 (upper Eocene, Curacao and Bonaire).

*Gümbelina goodwini* Cushman and Jarvis, *in* Cushman, 1933, p. 69, pl. 7, figs. 15, 16 (upper Eocene, Trinidad, B. W. I.).— Bermudez, 1938, p. 11 (Eocene, Cuba).—Cushman and Renz, 1948, p. 23 (Eocene, Trinidad, B. W. I.).

*Gümbelina venezuelana* Nuttall, 1935, p. 126, pl. 15, figs. 2–4 (upper Eocene, Venezuela).—Cushman, 1939, p. 62, pl. 10, figs. 50–53 (Eocene, North Atlantic Ocean).—Cushman and Todd, 1945b, p. 94, pl. 15, fig. 9 (upper Eocene, Mississippi, U. S. A.).—Cushman, 1946, p. 22, pl. 4, fig. 29 (upper Eocene, Alabama, U. S. A.).—Cushman and Stone, 1947, p. 10, pl. 1, fig. 28 (Eocene, Peru).—Cushman and Stainforth, 1951, p. 149, pl. 26, fig. 23 (upper Eocene, Peru).

The long list of references and synonyms indicates that *Chiloguembelina martini* is widespread in the American Eocene and shows considerable variability. The synonymy is, in principle, that proposed by Drooger (1953). The range of variation at various stratigraphic levels is illustrated by a series of text-figures. The younger specimens (text-fig. 14, Nos. 20–23) are usually slightly larger than those from the lower part of the Navet formation (text-fig. 14, Nos. 9–11) and their chambers are often more inflated and show a greater increase in size. Yet these minor differences are overshadowed by the individual variability within one sample.

Length: 0.2–0.32 mm.

Occurrence: Upper Lizard Springs (*Globorotalia aragonensis* zone), Navet and San Fernando formations (Eocene).

Types: Figured hypotypes (USNM P5759, 5760a–c, 5761a–e, 5762a–d) and unfigured hypotypes (USNM P5763).

#### Chiloguembelina cf. mauriciana (Howe and Roberts)

Plate 21, Figure 15; Text-figure 14 (12, 13, 19)

?*Gümbelina mauriciana* Howe and Roberts, *in* Howe, 1939. p. 62, pl. 8, figs. 9–11 (Eocene, Louisiana, U. S. A.).

*Gümbelina mauriciana* Cushman and Todd, 1945a, p. 16, pl. 4, fig. 2 (Eocene, Alabama, U. S. A.).

The Trinidad specimens are mostly shorter and thicker than the holotype of *Guembelina mauriciana*, but some resemble very closely the specimen figured by Cushman and Todd (1945a). Unfortunately the type description does not give any detail as to the variability of the species. It is therefore not possible to decide whether the Trinidad specimens can definitely be included in *Chiloguembelina mauriciana*.

The specimens here referred to *Chiloguembelina* cf. *mauriciana* (Howe and Roberts) are shorter and thicker than *C. martini* (Pijpers). The aperture is lower and often more symmetrical in shape and position. Many transitional forms exist, however, between the two groups, but they are here separated as they have different stratigraphic ranges.

Length: 0.14–0.22 mm.

Occurrence: Navet formation (Eocene), *Hantkenina aragonensis* zone to *Porticulasphaera mexicana* zone.

Types: Figured hypotypes (USNM P5764, 5765a, b, 5766) and unfigured hypotypes (USNM P5767).

**Chiloguembelina midwayensis midwayensis (Cushman)**

Plate 21, Figure 1; Text-figure 14 (24–27)

*Gümbelina midwayensis* Cushman, 1940, p. 65, pl. 11. fig. 15 (Paleocene, Alabama, U. S. A.)—Cushman and Todd, 1946a, p. 58, pl. 10, fig. 15 (Paleocene, Arkansas, U. S. A.).—Cushman, 1951, p. 37, pl. 11, figs. 7, 8 (Paleocene, Alabama, Arkansas, and Texas, U. S. A.).

The greatest number of typical specimens occurs in the *Globorotalia pusilla pusilla* zone. In the overlying *G. pseudomenardii* zone the variability of the species becomes greater, and at the same time closely related forms appear, i. e., *Chiloguembelina crinita* (Glaessner) and *C. midwayensis strombiformis*, new subspecies.

A characteristic not mentioned by Cushman in his original description is the asymmetrical shape of the aperture, an important feature of the *Chiloguembelina midwayensis* group and other species of *Chiloguembelina*.

Length: 0.2–0.3 mm.

Occurrence: Lower Lizard Springs formation (Paleocene).

Types: Figured hypotypes (USNM P5768, P5769a–d) and unfigured hypotypes (USNM P5770).

**Chiloguembelina midwayensis strombiformis Beckmann, new subspecies**

Plate 21, Figure 6; Text-figure 14 (28–31)

Test rapidly increasing in breadth, slightly compressed laterally. Periphery rounded. Chambers slightly inflated, biserially arranged, with their apertural faces not at right angles to the plane of greatest breadth of the test, thus giving the test a twisted appearance. Sutures depressed, slanting. Wall finely spinose. Aperture large, broader than high, surrounded by a transparent collar. One side of the aperture projects more than the other; its position is therefore oblique with regard to the general shape of the test.

Holotype from the Paleocene, lower Lizard Springs formation, *Globorotalia pseudomenardii* zone; Trinidad Petroleum Development Co. well Moruga No. 15, south Trinidad (coordinates N: 149878 links, E: 497002 links), core 3720–40 feet (TTOC 223472).

The variability of *Chiloguembelina midwayensis strombiformis* is illustrated by the text-figures 14, numbers 28–31. It increases more rapidly in size than *Chiloguembelina midwayensis midwayensis* and has a more spinose wall, more oblique sutures and a broader aperture. It is separated from *Chiloguembelina crinita* (Glaessner) by the lower, less globular chambers, the slightly coarser spinosity of the wall and the broader aperture.

Length: 0.23–0.3 mm.; holotype, 0.25 mm.

Occurrence: Lower Lizard Springs formation (Paleocene), *Globorotalia pseudomenardii* zone (common) and *Globorotalia velascoensis* zone (rare).

Types: Figured holotype (USNM P5771) and paratypes (USNM P5772 a–d), unfigured paratypes (USNM P5773).

**Chiloguembelina midwayensis subcylindrica Beckmann, new subspecies**

Plate 21, Figures 2, 3; Text-figure 14 (32–35)

Test large for the genus, rapidly increasing in size in the early stages, only slightly increasing in the later portion, which may become almost cylindrical. Chambers biserially arranged, moderately inflated. Sutures depressed, slightly slanting. Wall very finely spinose. Aperture fairly large, about as broad as high, oblique to the plane of greatest breadth of the test, usually with a narrow transparent collar. The aperture is sometimes covered by a small end chamber (pl. 21, fig. 3).

Holotype from the lower Eocene, upper Lizard Springs formation, *Globorotalia formosa formosa* zone, about 1¼ miles southeast of the junction between the Rio Claro-Guayaguayare Road and the road to the abandoned Lizard Springs oilfield, southeast Trinidad, 120 feet north of small Ampelu River tributary described as type section of the Lizard Springs formation by Cushman and Renz (1946), and 130 feet east of Ampelu River (coordinates N:187160 links, E:556600 links), collected by K. W. Barr (No. 6972) (TTOC 102301).

There is some variation in the length to breadth ratio of the test and in the degree of inflation of the chambers as shown in the text-figure. *Chiloguembelina midwayensis subcylindrica*, new subspecies, differs from *C. midwayensis midwayensis* (Cushman) in the larger size of the test, the greater increase in size of the early chambers, and in the shape of the later part of the test, which is much thicker and often almost cylindrical. It is separated from *C. midwayensis strombiformis*, new subspecies, by its larger size, more cylindrical test, higher chambers and less oblique sutures. The little end chamber which covers the aperture of some specimens of *C. midwayensis subcylindrica* is absent in other subspecies of *C. midwayensis*.

Length: 0.25–0.42 mm.; holotype, 0.4 mm.

Occurrence: Upper Lizard Springs formation (lower Eocene), *Globorotalia rex* and *Globorotalia formosa formosa* zones.

TYPES: Figured holotype (USNM P5774) and paratypes (USNM P5775, 5776a–d), unfigured paratypes (USNM P5777).

### Chiloguembelina cf. multicellaris (Hussey)

PLATE 21, FIGURE 17

?*Gümbelina multicellaris* HUSSEY, 1949, p. 130, pl. 27, fig. 10 (Eocene, Louisiana, U. S. A.).

The specimens from Trinidad are rare and badly preserved. They are similar to Hussey's species, but the chambers increase more regularly in size. The Trinidad specimens differ from *Chiloguembelina cubensis* (Palmer) in having a larger, arched aperture, but the shape of the test is the same as in many slender specimens of *Chiloguembelina cubensis.*

LENGTH: 0.15–0.2 mm.

OCCURRENCE: Navet formation (Eocene), *Hantkenina aragonensis* zone to *Globorotalia lehneri* zone.

TYPES: Figured hypotype (USNM P5778) and unfigured hypotypes (USNM P5779).

### Chiloguemblina parallela Beckmann, new species

PLATE 21, FIGURE 8; TEXT-FIGURE 15 (36–38)

Test short, thick, rapidly tapering towards the base, slightly compressed. Chambers subglobular, usually 8 to 12 in number, biserially arranged, rapidly increasing in size. Sutures oblique, depressed. Wall smooth or slightly spinose. Aperture high and narrow, symmetrical, bordered by two parallel lateral flanges, occasionally covered by a small end chamber of irregular shape (text-fig. 15, Nos. 36, 38).

Holotype from the lower Eocene, upper Lizard Springs formation, *Globorotalia rex* zone, left bank tributary of Cascas River, 180 feet from its junction with the Cascas River, Moruga, south Trinidad (coordinates N:138700 links, E:435000 links), collected by L. W. Hawkins (No. 1831) (TTOC 228484).

This species is easily separated from other species of *Chiloguembelina* by its symmetrical, high and narrow aperture. Its restricted range makes it a good index fossil. The holotype is a large specimen, hence a few smaller paratypes are illustrated in the text-figure in order to give the full size range of the species.

LENGTH: 0.22–0.42 mm.; holotype 0.4 mm.

OCCURRENCE: Upper Lizard Springs formation (lower Eocene), *Globorotalia rex* zone.

TYPES: Figured holotype (USNM P5780) and paratypes (USNM P5781a–c), unfigured paratypes (USNM P5782).

### Chiloguembelina subtriangularis Beckmann, new species

PLATE 21, FIGURE 5; TEXT-FIGURE 15 (39–42)

Test small, subtriangular, pointed at the base, compressed, with a subangular periphery. Chambers biserial, very slightly inflated. Sutures nearly horizontal, slightly depressed, at least in the later stages. Wall smooth. Aperture commonly slightly eccentric, semicircular to subquadrangular, may have a slight collar.



Holotype from the Paleocene, lower Lizard Springs formation, *Globorotalia pusilla pusilla* zone. Locality: TTOC well Guayaguayare No. 159, southeast Trinidad (coordinates N:151361 links, E:554095 links), core 4778–90 feet (TTOC 232706).

The compressed, subtriangular test makes it easy to distinguish *Chiloguembelina subtriangularis*, new species, from other *Chiloguembelina* species. The variability is shown in the text-figure but the extreme forms (Nos. 39 and 42) are rare. *C. subtriangularis* occurs in all zones of the lower Lizard Springs formation, but is most common in the *Globorotalia pusilla pusilla* zone. The specimens from the *Globorotalia trinidadensis* zone have a more rounded periphery, slightly curved sutures and resemble compressed specimens of *C. midwayensis midwayensis.*

LENGTH: 0.14–0.22 mm.; holotype, 0.21mm.

OCCURRENCE: Lower Lizard Springs formation (Paleocene).

TYPES: Figured holotype (USNM P5783) and paratypes (USNM P5784a–d), unfigured paratypes (USNM P5785).

### Chiloguembelina trinitatensis (Cushman and Renz)

PLATE 21, FIGURE 7; TEXT-FIGURE 15 (43–45)

*Gümbelina trinitatensis* CUSHMAN and RENZ, 1942, p. 8, pl. 2, fig. 8 (Paleocene, Soldado Rock, Trinidad, B.W.I.).—CUSHMAN, 1951, p. 38, pl. 11, fig. 9 (same locality).

The specimens from Trinidad, especially those from the Lizard Springs type area, are commonly slightly larger than the types from Soldado Rock, but the other morphological characters are the same.

LENGTH: 0.26–0.38 mm.

OCCURRENCE: Lower Lizard Springs formation (Paleocene), *Globorotalia velascoensis* zone.

TYPES: Figured hypotypes (USNM P5786, P5787a–c) and unfigured hypotypes (USNM P5788).

### Chiloguembelina victoriana Beckmann, new species

PLATE 21, FIGURES 19, 20; TEXT-FIGURE 15 (46–48)

Test elongate, slender, somewhat compressed. Periphery rounded, slightly lobate. Chambers biserial, broader than high, slightly inflated. Sutures straight, depressed, oblique in the early portion of the test, later more or less horizontal. Wall smooth. Aperture semicicular, sometimes with a faint lip, in an oblique position, i. e., with one side projecting more than the other.

Holotype from the upper Eocene, San Fernando formation, *Globorotalia cocoaensis* zone, Branch of Pointe-a-Pierre Road, between Joga Grant Street and Jarvis Street, San Fernando, Trinidad, 90 feet east of southern end of Joga Grant Street (coordinates N:239020 links, E:363330 links), collected by H. G. Kugler (No. 9613) (TTOC 240966).

The variability of the species is shown by the text-figure. The specimens from the upper Eocene (pl. 21, fig. 19) are, on an average, slightly more elongated than the specimens from the Oligocene (pl. 21, fig. 20). Some specimens are moderately twisted at the base, but the biserial chamber arrangement is maintained throughout the test.

*Chiloguembelina victoriana*, new species, differs from *Chiloguembelina cubensis* (Palmer) in its higher and narrower aperture, smooth wall surface, and somewhat less inflated chambers.

The name *Chiloguembelina victoriana* is derived from the county of Victoria, Trinidad, where the species is found in various surface localities (San Fernando area, Cipero Coast section).

Length: 0.15–0.22 mm.; holotype, 0.2 mm.

Occurrence: San Fernando formation (upper Eocene), *Globorotalia cocoaensis* zone. Cipero formation (Oligocene), *Globigerina ampliapertura* zone (lower part).

Types: Figured holotype (USNM P5789) and paratypes (USNM P5790, P5791a–c), unfigured paratypes (USNM P5792).

**Chiloguembelina wilcoxensis (Cushman and Ponton)**

Plate 21, Figures 10, 12, 13; Text-figure 15 (49–58)

*Gümbelina wilcoxensis* Cushman and Ponton, 1932, p. 66, pl. 8, figs. 16, 17 (lower Eocene, Alabama, U. S. A.).—Toulmin, 1941, p. 597, pl. 80, fig. 24 (lower Eocene, Alabama, U. S. A.).

With its globular chambers and its symmetrical, semicircular aperture, *Chiloguembelina wilcoxensis* is easily distinguished from other *Chiloguembelina* species, but is similar to some Cretaceous species of *Heterohelix* (formerly *Guembelina*).

Loeblich and Tappan (1956) do not mention this species among those to be included in *Chiloguembelina*. However, like *C. trinitatensis* Cushman and Renz, which has no twisted test or asymmetrical apertural flap either, it seems to develop from *C. crinita*, which is a typical *Chiloguembelina* (see p. 89). Therefore *C. trinitatensis* and *C. wilcoxensis* are probably not directly related to the Cretaceous *Heterohelix*. The genus description of *Chiloguembelina* does not exclude species with symmetrical test. The necklike extension of the aperture mentioned by Loeblich and Tappan is present in many specimens of *C. wilcoxensis*, especially the earlier ones.

There is a distinct increase in size from the lowest to the highest occurrence of the species. A few specimens show a small end chamber covering the aperture of the last regular chamber, as in plate 21, figure 13, and text-figure 15 (No. 56).

Length: 0.2–0.58 mm.

Occurrence: Lizard Springs formation (Paleocene and lower Eocene), *Globorotalia pseudomenardii* zone to *Globorotalia formosa formosa* zone.

Types: Figured hypotypes (USNM P5793, P5794, P5795, P5796a–d, P5797a–c, P5798a–c) and unfigured hypotypes (USNM P5799).

**Chiloguembelina sp.**

Plate 21, Figure 18

Rather slender, elongate, more or less compressed specimens with a low, arched, asymmetrical aperture are fairly common in the lower and middle part of the Navet formation. They are rather badly preserved and several important characters, e. g., wall surface and exact shape of the aperture, are difficult to determine. Specimens similar to the figured type are particularly frequent, others resemble *Chiloguembelina garretti* (Howe) and *Chiloguembelina victoriana* n. sp.

Length: 0.15–0.24 mm.

Occurrence: Navet formation (Eocene), *Hantkenina aragonensis* zone to *Globorotalia lehneri* zone. Scarce and not typical specimens occur in the *Porticulasphaera mexicana* zone.

Types: Figured specimen (USNM P5800).

## Genus Guembelitria Cushman, 1933

**Guembelitria columbiana Howe**

Plate 21, Figure 16

*Gümbelitria columbiana* Howe, 1939, p. 62, pl. 8, figs. 12–13 (Eocene, Louisiana, U. S. A.).—Cushman and Todd, 1945a, p. 16, pl. 4, fig. 3 (Eocene, Alabama, U. S. A.).—Hussey, 1949, p. 131 (Eocene, Louisiana, U. S. A.).

Typical representatives of this species are common in the lower and middle part of the Navet formation.

Length: 0.12–0.18 mm.

Occurrence: Navet formation (Eocene), *Hantkenina aragonensis* zone to *Porticulasphaera mexicana* zone.

Types: Figured hypotype (USNM P5801) and unfigured hypotypes (USNM P5802).

## Genus Zeauvigerina Finlay, 1939

**Zeauvigerina aegyptiaca Said and Kenawy**

Plate 21, Figures 9, 11; Text-figure 15 (59–62)

*Zeauvigerina aegyptiaca* Said and Kenawy, 1956, p. 141, pl. 4, fig. 1 (Maestrichtian and Paleocene, Egypt).

The specimens from Trinidad agree in shape and size with the type description. The stratigraphic range of the species seems to be shorter than in Egypt. In Trinidad, it is restricted to the upper part of the Paleocene. This is about the same level as that of the type sample (No. 8, Nekhl section, see Said and Kenawy, 1956, p. 107, text-fig. 1).

There is considerable variation in length and breadth of the test. The size and shape of the last chamber is very irregular, and the terminal neck with the aperture can be short and wide or long and narrow. The wall of the last chamber is thinner and more fragile than that of the previous chambers.

There is some controversy about the relationship between *Zeauvigerina* Finlay, 1939, and *Eouvigerina* Cushman, 1926 (Loeblich, 1951, p. 110; Said and Kenawy, 1956, p. 141). The arrangement of chambers is biserial in both genera. The main difference lies in the last chambers. In *Zeauvigerina* the long apertural neck is present in the terminal end chamber only. If this chamber is missing or broken off, the test looks like a *Chiloguembelina*. The aperture is then at the base of the last chamber, semicircular and often slightly eccentric in position (see pl. 21, fig. 9).

This was also noted by Finlay in his description of *Zeauvigerina teuria* (Finlay, 1947, p. 276). *In Eouvigerina*, on the other hand, tubular projections are present in a number of earlier chambers as well and are usually connected by a thin, band-like structure. For this reason, the author is inclined to retain the name *Zeauvigerina* for the present. A definite solution of the problem will depend on a detailed examination of additional species of both genera, and on the possible discovery of intermediate forms.

LENGTH: 0.25–0.38 mm.

OCCURRENCE: Lower Lizard Springs formation (Paleocene), *Globorotalia pseudomenardii* zone and *Globorotalia velascoensis* zone (lower part).

TYPES: Figured hypotypes (USNM P5803, P5804, P5805a–d) and unfigured hypotypes (USNM P5806).

## References


BANDY, O. L.

1949. Eocene and Oligocene Foraminifera from Little Stave Creek, Clarke County, Alabama. Bull. Amer. Paleontol., vol. 32, No. 131, pp. 5–240.

BECKMANN, J. P.

1953. Die Foraminiferen der Oceanic Formation (Eocaen-Oligocaen) von Barbados, Kl. Antillen. Eclog. Geol. Helvetiae, vol. 46, pp. 301–412.

BERMUDEZ, P. J.

1937. Nuevas especies de foraminiferos del Eoceno de Cuba. Mem. Soc. Cubana Hist. Nat., vol. 11, pp. 137–150, pls. 16–19.

1938. Foraminiferos pequenos de las margas eocenicas de Guanajay, Provincia Pinar del Rio, Cuba. Mem. Soc. Cubana Hist. Nat., vol. 12, pp. 1–26.

1949. Tertiary smaller Foraminifera of the Dominican Republic. Cushman Lab. Foram. Res., Spec. Publ. 25, pp. 1–322.

BOLLI, H. M.

1957a. The genera *Globigerina* and *Globorotalia* in the Paleocene-lower Eocene Lizard Springs formation of Trinidad, B.W.I. U. S. Nat. Mus. Bull. 215, pp. 1–81, pls. 15–20.

1957b. Planktonic Foraminifera from the Eocene Navet and San Fernando formations of Trinidad, B.W.I. U. S. Nat. Mus. Bull. 215, pp. 155–172, pls. 35–39.

1957c. Planktonic Foraminifera from the Oligocene-Miocene Cipero and Lengua formations of Trinidad, B.W.I. U. S. Nat. Mus. Bull. 215, pp. 97–123, pls. 22–29.

BOLLI, H. M., LOEBLICH, A. R., Jr., and TAPPAN, H.

1957. The planktonic foraminiferal families Hantkeninidae, Orbulinidae, Globorotaliidae and Globotruncanidae. U. S. Nat. Mus. Bull. 215, pp. 3–50, pls. 1–11.

CUSHMAN, J. A.

1933. Post-Cretaceous occurrence of *Gümbelina* with a description of a new species. Contr. Cushman Lab. Foram. Res., vol. 9, pp. 64–69.

1939. Eocene Foraminifera from submarine cores off the eastern coast of North America. Contr. Cushman Lab. Foram. Res., vol. 15, pp. 49–76.

1940. Midway Foraminifera from Alabama. Contr. Cushman Lab. Foram. Res., vol. 16, pt. 3, pp. 51–73, pls. 9–12.

1946. A rich foraminiferal fauna from the Cocoa sand of Alabama. Cushman Lab. Foram. Res., Spec. Publ. 16, pp. 1–40.

1948. Foraminifera: their classification and economic use. Cambridge, Massachusetts, pp. i–ix, 1–605.

1951. Paleocene Foraminifera of the Gulf Coastal region of the United States and adjacent areas. U. S. Geol. Survey, Prof. Paper 232, pp. 1–75.

CUSHMAN, J. A., and PONTON, G. M.

1932. An Eocene foraminiferal fauna of Wilcox age from Alabama. Contr. Cushman Lab. Foram. Res., vol. 8, pp. 51–72.

CUSHMAN, J. A., and RENZ, H. H.

1942. Eocene, Midway, Foraminifera from Soldado Rock, Trinidad. Contr. Cushman Lab. Foram. Res., vol. 18, pp. 1–14.

1946. The foraminiferal fauna of the Lizard Springs formation of Trinidad, British West Indies. Cushman Lab. Foram. Res., Spec. Publ. 18, pp. 1–48.

Cushman, J. A., and Renz, H. H. (Cont.)

1948. Eocene Foraminifera of the Navet and Hospital Hill formations of Trinidad, B.W.I. Cushman Lab. Foram. Res., Spec. Publ. 24, pp. 1–42.

Cushman, J. A., and Stainforth, R. M.

1951. Tertiary Foraminifera of coastal Ecuador. Part I, Eocene. Journ. Paleontol., vol. 25, pp. 129–164.

Cushman, J. A., and Stone, B.

1947. An Eocene foraminiferal fauna from the Chira shale of Peru. Cushman Lab. Foram. Res., Spec. Publ. 20, pp. 1–27.

Cushman, J. A., and Todd, R.

1945a. A foraminiferal fauna from the Lisbon formation of Alabama. Contr. Cushman Lab. Foram. Res., vol. 21, pp. 11–21.

1945b. Foraminifera of the type locality of the Moodys marl member of the Jackson formation of Mississippi. Contr. Cushman Lab. Foram. Res., vol. 21, pp. 79–105.

1946a. A foraminiferal fauna from the Paleocene of Arkansas. Contr. Cushman Lab. Foram. Res., vol. 22, pp. 45–65.

1946b. A foraminiferal fauna from the Byram marl at its type locality. Contr. Cushman Lab. Foram. Res., vol. 22, pp. 76–102.

Drooger, C. W.

1953. Late Eocene smaller Foraminifera from Curacao and Bonaire (N.W.I.). Proc. Nederl. Akad. Wetenschappen, ser. B, vol. 56, No. 1, pp. 93–103.

Finlay, H. J.

1947. New Zealand Foraminifera: key species in stratigraphy—No. 5. New Zealand Journ. Sci. Technol., sect. B, vol. 28, No. 5. pp. 259–292.

Glaessner, M. F.

1937. Studien über Foraminiferen aus der Kreide und dem Tertiär des Kaukasus. Probl. Paleontol., Moscow Univ. Lab. Paleontol., vol. 2–3, pp. 349–410, pls. 1–5.

1945. Principles of micropaleontology. Melbourne University Press, pp. i–xvi, 1–296.

Hofker, J.

1954. On Tertiary *Gümbelina* and some species of *Bolivina*. The Micropaleontologist, vol. 8, No. 1, pp. 29–30.

Howe, H. V.

1939. Louisiana Cook Mountain Eocene Foraminifera. Louisiana Dep. Cons., Geol. Surv. Bull. 14, pp. 1–122, pls. 1–14.

Hussey, K. M.

1949. Louisiana Cane River Eocene Foraminifera. Journ. Paleontol., vol. 23, pp. 109–144.

Loeblich, A. R., Jr.

1951. Coiling in the Heterohelicidae. Contr. Cushman Found. Foram. Res., vol. 2, pp. 106–110.

Loeblich, A. R., Jr., and Tappan, H.

1956. *Chiloguembelina*, a new Tertiary genus of the Heterohelicidae (Foraminifera). Journ. Washington Acad. Sci., vol. 46, No. 11, p. 340.

Montanaro Gallitelli, E.

1955. Una revisione della famiglia Heterohelicidae Cushman. Mem. Accad. Sci. Lett. Arti Modena, ser. 5, vol. 13, pp. 213–223.

Nuttall, W. L. F.

1935. Upper Eocene Foraminifera from Venezuela. Journ. Paleontol., vol. 9, pp. 121–131, pls. 14–15.

Palmer, D. K.

1934. The foraminiferal genus *Gümbelina* in the Tertiary of Cuba. Mem. Soc. Cubana Hist. Nat., vol. 8, pp. 73–76.

1940. Foraminifera of the upper Oligocene Cojimar formation of Cuba. Part 3. Mem. Soc. Cubana Hist. Nat., vol. 14, No. 4, pp. 277–304.

Palmer, D. K., and Bermudez, P. J.

1936. An Oligocene foraminiferal fauna from Cuba. Mem. Soc. Cubana Hist. Nat., vol. 10, pp. 227–316.

PIJPERS, P. J.

1933. Geology and Paleontology of Bonaire (D. W. I.). Univ. Utrecht Geogr. Geol. Med., Phys.-Geol. Reeks, No. 8, pp. 1–103.

RENZ, H. H.

1948. Stratigraphy and fauna of the Agua Salada group, State of Falcón, Venezuela. Geol. Soc. Amer., Mem. 32, pp. i–x, 1–219.

SAID, R,. and KENAWY, A.

1956. Upper Cretaceous and Lower Tertiary Foraminifera from northern Sinai, Egypt. Micropaleontology, vol. 2, pp. 105–173.

TOULMIN, L. D.

1941. Eocene smaller Foraminifera from the Salt Mountain limestone of Alabama. Journ. Paleontol., vol. 15, pp. 567–611.